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PROCEDURE

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Use and document-control boundary

This companion implements the supplied AF 9100 requirement basis without changing the original standard. Its process allocation, examples, checklists and record design are authored implementation material. Actual mission or product limits, specialist procedures, permissions and genuine observations must be completed before consequential use. Applicable source minima and independent decision conditions cannot be reduced by this companion.

The printed edition date identifies the companion series; it is not evidence that later preparation, review or operational decisions occurred on that date. New support codes in this set are proposed allocations for controlled registration. Established AF-IG-9100-001, AF-FAQ-9100-001 and AF-TR-9100-001 identities are retained; earlier files, the corporate master list and ASTRA codes are not overwritten.

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Contents and reading route

Publication identity and application	2
Contents and reading route	3
1 Scope, responsibility and source priority	4
2 Trigger, inputs and handover	4
3 Operating sequence	4
4 Decision, interruption and escalation	5
5 Required records and receiving checks	5
6 Worked case and adverse challenge	5
Appendix A — Controlling source and evidence	7
Source tables — complete field and decision payloads	13
Appendix B — Local implementation and release	15

Select actual scope → complete application criteria → use the applicable procedure and technical book → capture authentic evidence → evaluate every applicable condition → obtain the required independent decision. Document availability does not establish implementation or conformity.

1 Scope, responsibility and source priority

Applies to the responsible function and exact evaluated object selected from the source. Use only the duties triggered by actual activity and retained responsibility.

Boundary	Required implementation decision
Object and route	Identify ORG, PRD, SVC, PRC, PER, SUB or CAB separately. Combined records do not merge outcomes.
Activity	Apply source technical modules by performed or retained responsibility, including relevant outsourced work.
Authority	Technical release, employer task permission, independent attestation and statutory authorization remain distinct.
Source priority	AF 9100:2026 and all compatible binding obligations control. This companion does not import ASTRA programme rules or external normative schemes.

2 Trigger, inputs and handover

Trigger: Performance reporting, reliability claim, trend review or customer-feedback evaluation.

Accountable process owner: Performance and reliability owner. Actual named appointments and deputies are maintained locally.

Input to verify	Required output / receiving function
Exact request, object and source profile	Accepted scope and controlled work package, or a reasoned hold/refusal.
Current people, authority, data and equipment	Authorized assignment and evidence-access boundary.
Original execution, adverse evidence and source history	Attributable result, identified limitations and required action.
Relevant source clocks and actual event times	Genuine due/completion history and timely recipient communication.

3 Operating sequence

3.1 Define each question

Specify population, configuration, duty, exposure, failure, downtime, observation window and intended inference. Distinguish prediction, demonstration, field observation and qualification.

3.2 Validate data and selection

Check missing records, censoring, repeated observations, repaired configurations and sampling. Reconcile metrics to source transactions and retain adverse outcomes.

3.3 Select the model

Use a distribution and dependence model suited to the actual mechanism. Separate process control from specification, and confidence bounds from point estimates or monitoring percentages.

3.4 Compute transparently

Retain formulas, units, inputs, uncertainty and known-answer checks. Apply the Technical Reports methods only within their stated assumptions; undefined denominators remain undefined.

3.5 Review by meaningful groups

Examine product, site, supplier, configuration, delivery mode and critical scenario differences. Compare customer acceptance with actual user experience rather than treating no complaints as proof of satisfaction.

3.6 Act and communicate limits

Link adverse trends to correction, hazards, supplier controls and resources. Report bounded findings; no uptime, capability index or customer score cancels an essential conformity failure.

4 Decision, interruption and escalation

An invalid model or unspecified denominator prevents the unsupported numerical claim.

State or event	Action and limit
Evidence valid and criteria met	Record the bounded result and pass it to the authorized receiving function; do not enlarge scope.
Evidence missing, invalid or inconclusive	Keep the dependent conclusion not yet demonstrated / HOLD, preserve the reason and define competent next work.
Valid evidence demonstrates failure	Record nonconformity and protect the affected population; follow actual technical disposition and source status controls.
Trigger genuinely absent	Record the exclusion and its approved responsibility basis. Resource shortages do not justify N/A.
Interrupted or changed work	Preserve prior state and actual configuration; complete impact and revalidation before claiming completion.

5 Required records and receiving checks

Document	Record purpose
AF-FR-9100-027	Metrics, Reliability and Customer Performance
AF-FR-9100-014	Risk, Hazard, Criticality and Residual Decision
AF-FR-9100-006	Nonconformity, Containment and Corrective Action

At handover the receiver checks object, scope, current version, original evidence, open conditions, true event chronology and the action they may authorize. An email sent, field marked complete or invoice paid is not acceptance of that handover.

6 Worked case and adverse challenge

Synthetic scenario: A service has 96% availability while some available periods produce incorrect data.

Required reasoning: Report availability and output correctness separately and investigate affected outputs. The availability measure does not prove technical validity.

Challenge before local use	Expected behavior
Missing essential input	Dependent conclusion remains held; no favorable default.
Wrong configuration or performer	Detect the mismatch and reassess relevant evidence.
Expired or conflicted authority	Block the prohibited assignment or decision; later renewal cannot validate earlier unauthorized work.
Failed mandatory condition with high total score	No compensation; preserve the failure and required action.

Challenge before local use	Expected behavior
Correction without original history	Reject an apparent closure that erases relevant earlier evidence.

Appendix A — Controlling source and evidence

Source: AF 9100:2026, Aerospace Quality Management System, FIRST EDITION, 29 September 2026; supplied 131-page PDF. Source page references below locate the original publication. These excerpts are read with the complete applicable standard; local implementation sequences do not replace it.

9.1 Monitoring strategy and data credibility

SOURCE p. 26 | Normative when applicable

9.1(a) The organization shall define what will be monitored, why it matters, how it is measured, when it is evaluated and who acts on the result. Measures shall connect process performance to product conformity, delivery, reliability, safety, customer experience and evidence integrity.

9.1(b) Data shall retain configuration, exposure, time period and denominator information needed for interpretation. Automated dashboards shall be reconciled to source records. Missing, delayed or selectively excluded data shall be visible. Leading indicators shall be evaluated against outcomes to confirm their usefulness.

Required evidence: Monitoring plan; metric dictionary; source reconciliations; data-quality checks; action records.

9.2 Customer satisfaction and external feedback

SOURCE p. 26 | Normative when applicable

9.2(a) The organization shall monitor customer and relevant user perceptions through suitable methods, including complaints, delivery experience, acceptance issues, service performance and corrective-action requests. Absence of complaints shall not be the sole evidence of satisfaction.

9.2(b) Trends shall be analyzed by meaningful product, site, supplier or configuration groups. Improvement plans shall address identified weaknesses and assess whether the customer or user experience actually improved. Contractual acceptance and user satisfaction shall be distinguished.

Required evidence: Feedback records; segment analysis; improvement plans; effectiveness evaluations.

11.4 Reliability, availability and maintainability

SOURCE p. 28 | Normative when applicable

11.4(a) RAM requirements shall be derived from operational needs, exposure, consequence, support concept and applicable obligations. The organization shall state the population, mission duration, failure definition, repair boundary, confidence and statistical assumptions associated with every numerical claim.

11.4(b) Analysis shall address failure mechanisms, dependencies, common causes, wear-out, maintenance-induced failure, dormant failures and environmental stress as relevant. Predicted reliability shall be distinguished from demonstrated performance. Qualification tests shall not be interpreted as proving rare-event safety rates without a defensible statistical and engineering basis.

11.4(c) Maintainability shall consider access, diagnosis, repair errors, tools, spares, human factors and verification after intervention. Availability claims shall identify whether logistics and administrative downtime are included. Annex F provides worked methods and limits.

Required evidence: RAM plan; models and assumptions; test plan; field exposure; repair-time and downtime definitions.

F.1 Exponential mission-reliability example

SOURCE p. 59 | Definition, explanation or informative example; no new universal limit

F.1(a) Assume a non-repairable item has a constant failure rate $\lambda = 2 \times 10^{-5}$ per operating hour over the demonstrated domain. For mission duration t , $R(t) = \exp(-\lambda t)$. At 1,000 hours, $R = \exp(-0.02) = 0.9801987$; at 5,000 hours, $R = \exp(-0.10) = 0.9048374$.

F.1(b) The model requires a credible constant-rate region and a consistent failure definition. It does not describe wear-out, early failures, changing stress, systematic software defects or maintenance effects unless those phenomena are separately represented. A numerical prediction is not a confidence bound or proof of mission safety.

Source calculation note: (F-1) $R(t) = \exp(-\lambda t)$; $\lambda = 1 / \theta$ λ is the constant failure rate in h^{-1} ; t is operating time in h ; θ is the corresponding mean life or mean inter-failure interval under the applicable exponential/HPP model. λt is dimensionless.

F.2 Series and parallel systems

SOURCE p. 59 | Definition, explanation or informative example; no new universal limit

F.2(a) Three independent series elements with mission reliabilities 0.990, 0.995 and 0.998 produce system reliability $0.990 \times 0.995 \times 0.998 = 0.9830799$. Every series element is required for the modeled success event.

F.2(b) Two independent active parallel elements, each with mission reliability 0.98, give $1 - (1 - 0.98)^2 = 0.9996$ if either element alone provides the required function. This assumes perfect switching or load-sharing behavior where relevant, no common-cause failure and no harmful interaction. Annex E demonstrates how a shared failure can dominate the result.

Source calculation note: Figure F-1 — Synthetic exponential reliability curves. The three constant rates are illustrative model assumptions, not measured aircraft, vehicle or spacecraft failure rates. (F-2) $R_{\text{series}} = \prod R_i$; $R_{\text{parallel}} = 1 - \prod (1 - R_i)$ The product formulas require appropriate independence. The parallel formula also requires that any one surviving element is sufficient for the modeled mission function.

F.3 Zero-failure binomial demonstration

SOURCE p. 59 | Definition, explanation or informative example; no new universal limit

F.3(a) For n independent, identically distributed trials with all n successes, a one-sided exact lower confidence bound on the success probability is $R_L = \alpha^{(1/n)}$. To demonstrate R_L at least R_0 with confidence $1 - \alpha$, choose n at least $\ln(\alpha)/\ln(R_0)$ and round upward.

F.3(b) At 95% confidence and target $R_0 = 0.99$, $n = \text{ceil}[\ln(0.05)/\ln(0.99)] = 299$ successful trials with no failures. With 300 successes, the bound is 0.9900639. This is not a claim that the next trial is guaranteed to succeed. The confidence statement describes the coverage of the procedure under its model.

Source calculation note: (F-3) $n = \text{ceil}[\ln(\alpha) / \ln(R_0)]$; $R_L = \alpha^{(1/n)}$ $0 < \alpha < 1$ and $0 < R_0 < 1$. Trials must have the declared mission conditions and failure criteria. Repeated dependent trials on the same article may not provide n independent observations.

Figure F-2 — Required all-success trials versus target reliability at 90% and 95% confidence. Logarithmic vertical scale; independent Bernoulli trials assumed.

F.4 Time-on-test with no failures

SOURCE p. 60 | Definition, explanation or informative example; no new universal limit

F.4(a) For a constant-rate model with total valid exposure T and zero failures, the one-sided upper rate bound is $\lambda_U = -\ln(\alpha)/T$. With $T = 60,000$ item-hours and 95% confidence, $\lambda_U = 4.992887 \times 10^{-5} \text{ h}^{-1}$. The corresponding lower mean-life bound is 20,028.492 hours.

F.4(b) Pooling exposure across units requires the same relevant failure mechanism and rate model. Parallel testing reduces calendar time, not the required total exposure. A 60,000-hour exposure does not mean that one article has demonstrated a 60,000-hour wear-out life.

Source calculation note: (F-4) $\lambda_U = -\ln(\alpha)/T$; $\theta_L = T/[-\ln(\alpha)]$ T is valid accumulated item-hours under a constant-rate model. Censoring and test interruptions must be recorded; excluded exposure requires a justified rule established before analysis.

F.5 Time-on-test with observed failures

SOURCE p. 60 | Definition, explanation or informative example; no new universal limit

F.5(a) For a fixed-time Poisson/HPP assessment with r observed failures and exposure T , a one-sided upper rate bound is $\chi^2(1 - \alpha; 2r + 2)/(2T)$. With $r = 3$, $T = 100,000$ hours and 95% confidence, the upper bound is $7.753657 \times 10^{-5} \text{ h}^{-1}$. The corresponding lower mean interval is approximately 12,897 hours.

F.5(b) The test plan and failure classification should be fixed before observing outcomes. Deleting early failures or treating repaired versions as unchanged units can invalidate the claim. If the rate changes over time, a reliability-growth or other suitable model is needed instead of mechanically applying this expression.

Source calculation note: (F-5) $\lambda_U = \chi^2(1 - \alpha; 2r + 2) / (2T)$ $\chi^2(p; \nu)$ denotes the lower-tail p quantile of a chi-square distribution with ν degrees of freedom. This notation avoids the ambiguity between upper-tail and lower-tail tables.

F.6 Weibull life and B10 example

SOURCE p. 60 | Definition, explanation or informative example; no new universal limit

F.6(a) For an illustrative two-parameter Weibull model with shape $\beta = 1.5$ and scale $\eta = 10,000$ hours, $R(t) = \exp[-(t/\eta)^\beta]$. At 5,000 hours, reliability is 0.7021885. The B10 life, where 10% of the modeled population has failed, is $\eta[-\ln(0.9)]^{(1/\beta)} = 2,230.755$ hours.

F.6(b) The example parameters are assumed, not fitted. In an actual program, estimation should address censoring, sample representativeness, uncertainty and mechanism validity. A B10 point estimate without a confidence bound may be insufficient for a life-limit decision. Extrapolating accelerated tests requires a validated acceleration relationship.

Source calculation note: (F-6) $R(t) = \exp[-(t/\eta)^\beta]$; $B_p = \eta[-\ln(1-p)]^{(1/\beta)}$ η has units of time; β is dimensionless; p is the cumulative failed fraction. The two-parameter model assumes zero location parameter.

F.7 Availability and repair boundaries

SOURCE p. 61 | Definition, explanation or informative example; no new universal limit

F.7(a) For an ideal alternating failure/repair model, intrinsic availability is $A_i = \text{MTBF}/(\text{MTBF} + \text{MTTR})$. With $\text{MTBF} = 1,200$ hours and mean active repair time 6 hours, $A_i = 0.9950249$, or 99.50249%. This excludes logistics and administrative delay.

F.7(b) For observed operational availability, a synthetic record of 960 available hours and 40 unavailable hours gives $A_o = 960/(960 + 40) = 0.96$, or 96%. The two values are not contradictory: their downtime boundaries differ. Reports should state whether scheduled maintenance, spares waiting, software recovery and external-service outages are included.

Source calculation note: (F-7) $A_i = \text{MTBF}/(\text{MTBF} + \text{MTTR})$; $A_o = \text{uptime}/(\text{uptime} + \text{downtime})$ Use consistent time units and an explicitly defined observation window. Availability does not imply that all operations performed while available are safe or successful.

F.8 Evidence checklist for reliability claims

SOURCE p. 61 | Definition, explanation or informative example; no new universal limit

F.8(a) A reliability report should state the failure definition, mission profile, population, configuration, exposure, censoring, independence assumptions, model choice, parameter estimation, confidence level and sensitivity. It should distinguish analysis, demonstration, qualification and field observation.

F.8(b) Before accepting a claim, the reviewer should ask whether common causes, software/systematic failures, environmental changes, repair effects and selection bias are represented. Confidence arithmetic cannot rescue an invalid physical or sampling model.

G.1 Study design and prerequisites

SOURCE p. 62 | Definition, explanation or informative example; no new universal limit

G.1(a) The characteristic is a nominal 50 mm dimension with illustrative limits $\text{LSL} = 49.970$ mm and $\text{USL} = 50.030$ mm. Five consecutive observations form each rational subgroup. The baseline consists of 125 observations; the monitoring phase is not included in estimating the initial limits.

G.1(b) Before using capability in an actual decision, establish measurement suitability, stable sampling conditions, rational subgrouping and a plausible distribution. Control limits describe process behavior; specification limits describe product requirements. A process can be stable but incapable, or unstable even while every observed part is within specification.

G.2 Within-subgroup variation and chart limits

SOURCE p. 62 | Definition, explanation or informative example; no new universal limit

G.2(a) The baseline grand mean is 50.00215328 mm and the average subgroup range is 0.013546 mm. For subgroup size five, use $d_2 = 2.326$, $A_2 = 0.577$, $D_3 = 0$ and $D_4 = 2.115$. The within-subgroup standard-deviation estimate is $R\text{-}\bar{d}_2 = 0.00582373$ mm.

G.2(b) The calculated $\bar{X}$ -bar limits are 49.99433724 and 50.00996932 mm. The range-chart upper limit is 0.02864979 mm and its lower limit is zero. These Phase-I estimates should be evaluated for stability; they should not be recalculated after every adverse point to hide a shift.

Source calculation note: (G-1) $s_{\text{within}} = R/d_2$; $\bar{X}$ limits = $\bar{\bar{X}} \pm A_2 R$; R limits = $D_3 R$, $D_4 R$ $\bar{\bar{X}}$ is the mean of subgroup means. R is the mean subgroup range. Constants depend on subgroup size; these values apply to $n=5$, not to arbitrary sample sizes. Figure G-1 — Baseline and subsequent monitoring subgroup means. Limits are estimated from groups 1–25 only; groups 26–30 deliberately illustrate a mean shift. Figure G-2 — Separate range chart for the same synthetic process. A stable range does not rule out a shifted process mean.

G.3 Capability and performance calculations

SOURCE p. 63 | Definition, explanation or informative example; no new universal limit

G.3(a) Using the within-subgroup estimate gives $C_p=1.717112$ and $C_{pk}=1.593865$. Using the overall sample standard deviation $s=0.00603166$ mm gives $P_p=1.657919$ and $P_{pk}=1.538920$. The definitions are stated explicitly because organizations sometimes use inconsistent naming conventions.

G.3(b) These point estimates are descriptive, not a universal acceptance decision. The program must define the required capability, estimation method and confidence treatment based on consequences and obligations. This standard does not declare that $C_{pk}=1.33$, 1.67 or any other number is sufficient for every critical characteristic.

Source calculation note: $(G-2) C_p = (USL - LSL)/(6s_{within})$; $C_{pk} = \min[(USL - \bar{x})/(3s_{within}), (\bar{x} - LSL)/(3s_{within})]$ P_p and P_{pk} use the corresponding formulas with the overall sample standard deviation $s_{overall}$. Capability interpretations based on normal tails require an appropriate distribution and a stable process. Figure G-3 — Histogram of the 125 synthetic baseline values with an illustrative fitted normal density and specification limits. The fit is not proof of normality.

G.4 Reaction to a special-cause signal

SOURCE p. 64 | Definition, explanation or informative example; no new universal limit

G.4(a) The monitoring subgroups were generated with a higher mean. A signal should trigger containment of the potentially affected interval, verification of the measurement system, investigation of process changes and appropriate product assessment. The range chart should be reviewed as well as the mean chart.

G.4(b) After an identified cause is corrected, the organization should verify stable operation before recalculating limits under an approved rule. Neither a favorable historical C_{pk} nor a high final inspection pass rate justifies ignoring a persistent shift.

G.5 Non-normal, dependent and low-volume data

SOURCE p. 64 | Definition, explanation or informative example; no new universal limit

G.5(a) For non-normal distributions, use a justified transformation or distribution-specific/percentile method and retain the interpretation of original specification limits. For autocorrelated data, select a model that accounts for dependence rather than assuming the nominal number of readings equals independent information.

G.5(b) Low-volume or one-off work may require engineering verification, validated processes and individual characteristic evidence instead of a capability index estimated from inadequate data. The absence of sufficient statistical data should be stated honestly; it should not be disguised by pooling unlike products.

G.6 Measurement-system variation example

SOURCE p. 64 | Definition, explanation or informative example; no new universal limit

G.6(a) As a separate synthetic illustration, suppose repeatability standard deviation is 0.0015 mm and reproducibility standard deviation is 0.0010 mm, with independent components. Combined gauge variation is $\sqrt{0.0015^2 + 0.0010^2} = 0.0018028$ mm. If observed total variation is 0.0060 mm, the ratio is 30.05%.

G.6(b) This calculation is only a component combination, not a complete gauge R&R study. A real study needs a suitable crossed or nested design, representative parts, operators, interactions and uncertainty. No universal accept/reject percentage is imposed; the effect on the actual measurement decision must be evaluated.

I.1 Define the sampling decision first

SOURCE p. 67 | Definition, explanation or informative example; no new universal limit

I.1(a) A sampling plan should identify lot formation, defect definition, random selection, sample size n , acceptance number c , measurement method, treatment of found defects, rejected-lot disposition and resubmission controls. The relevant consumer and producer risks should be agreed before inspection.

I.1(b) For a large homogeneous lot with independent Bernoulli defect status, the probability of acceptance is the binomial cumulative probability of at most c defective items. For finite lots sampled without replacement, the hypergeometric model is exact under random sampling.

Source calculation note: (I-1) $P_a(p) = \sum_{k=0}^c C(n,k) p^k (1-p)^{n-k}$ p is the defective fraction. The plan accepts the lot statistically when the observed number of defectives is at most c ; detected nonconforming items still require controlled disposition.

I.2 Plan selected from stated risk constraints

SOURCE p. 67 | Definition, explanation or informative example; no new universal limit

I.2(a) Assume an illustrative acceptable-quality point $p_A=0.005$ and poor-quality point $p_L=0.05$, with producer-risk limit $\alpha \leq 0.05$ and consumer-risk limit $\beta \leq 0.10$. Searching integer single-sample binomial plans gives the minimum sample size $n=105$ with $c=2$.

I.2(b) For this plan, $\alpha=1-P_a(0.005)=0.01605316$, or 1.6053%, and $\beta=P_a(0.05)=0.09918726$, or 9.9187%. These are calculated properties of the stated model; the chosen quality points are examples, not AF acceptance limits.

I.3 Finite-lot calculation

SOURCE p. 67 | Definition, explanation or informative example; no new universal limit

I.3(a) For a lot of $N=1,000$ containing $D=50$ defective items, sampling $n=105$ without replacement and accepting at most two gives $P_a=0.08696216$. For $D=5$, the corresponding probability is 0.99037961. The finite-lot result differs from the binomial approximation because sampling is without replacement.

I.3(b) The actual number of defectives is usually unknown; the calculation describes plan behavior at hypothetical lot states. It does not reveal the true defect count in an accepted lot. Sampling should be random across the defined lot, not restricted to easily accessible or best-looking items.

Source calculation note: $(I-2) P_a = \sum_{k=0}^c [C(D,k) C(N-D,n-k)] / C(N,n)$ Terms outside feasible ranges are zero. N is lot size, D is the hypothetical defective count and n is the sample size.

I.4 What zero defects in a sample means

SOURCE p. 68 | Definition, explanation or informative example; no new universal limit

I.4(a) If no defects are observed in 80 independent Bernoulli observations, a one-sided 95% upper confidence bound on the defect probability is $1-0.05^{(1/80)}=0.03675420$, or 3.6754%. Zero observed defects therefore does not establish a zero-defect population.

I.4(b) This confidence calculation is a parameter-inference statement, while an OC curve characterizes a decision plan. They answer different questions and should not be interchanged. A critical defect found in the sample should trigger the required technical containment and investigation, even when a generic count rule would otherwise accept the lot.

I.5 Resubmission, switching and detection limitations

SOURCE p. 68 | Definition, explanation or informative example; no new universal limit

I.5(a) Rejected lots should be segregated and dispositioned through a controlled process. Resubmission should disclose the original rejection, corrective or sorting action and the approved new inspection plan. Repeatedly drawing a fresh sample until one passes inflates acceptance probability and is not the stated plan.

I.5(b) The model presumes the inspection correctly classifies the sampled items. False-negative inspection, clustered defects, mixed lots and unrecorded substitutions can make calculated risks misleading. Inspection capability and lot integrity should therefore be considered together with the mathematical sample size.

Z.1 Metric definitions and numerical examples

SOURCE p. 101 | Definition, explanation or informative example; no new universal limit

Z.1(a) Each measure should have an owner, purpose, denominator, data source, reporting window, inclusion/exclusion rule and action threshold. Targets should be set before reporting. A favorable operational metric does not compensate for a mandatory conformity failure.

Z.1(b) The following examples are independent unless a shared dataset is explicitly stated. They should not be combined into a single invented organization's performance score.

Z.2 Margin definitions and reserve double counting

SOURCE p. 101 | Definition, explanation or informative example; no new universal limit

Z.2(a) Assume an available power capacity of 5.0 kW and a predicted demand of 4.0 kW for a stated condition. Margin relative to demand is $(5.0-4.0)/4.0=25\%$. Unused fraction of available capacity is $(5.0-4.0)/5.0=20\%$. Both calculations are correct but use different denominators.

Z.2(b) The budget should define which convention is used and whether uncertainty, degradation, contingency and reserve have already been included. Allocating the same reserve independently to multiple subsystems can overstate system margin. Simultaneous peak and transient conditions may require a separate assessment.

Source calculation note: (Z-1) $\text{Margin_relative_to_demand} = (\text{capacity} - \text{demand}) / \text{demand}$ Use the same physical quantity and compatible units. A nominal positive margin is not sufficient when the prediction uncertainty or unmodeled transients can consume it.

Z.3 Mission-support energy example

SOURCE p. 101 | Definition, explanation or informative example; no new universal limit

Z.3(a) Assume a non-flight mobile support unit has nominal stored energy 6.0 kWh. A predefined usable fraction of 0.80 already includes the chosen state-of-charge reserve; a condition factor of 0.85 and conversion efficiency of 0.90 are also assumed. Usable delivered energy is $6.0 \times 0.80 \times 0.85 \times 0.90 = 3.672$ kWh.

Z.3(b) If average loads are 0.72 kW propulsion, 0.18 kW computing and 0.10 kW auxiliaries, total average demand is 1.00 kW and the simplified endurance estimate is 3.672 hours. This does not demonstrate peak-power capability, thermal safety, terrain performance or battery life. The reserve shall not be deducted a second time without explaining the changed convention.

Source calculation note: (Z-2) $t_{\text{est}} = E_{\text{nominal}} \times f_{\text{usable}} \times f_{\text{condition}} \times \eta / P_{\text{average}}$ Energy in kWh divided by power in kW gives hours. The factors are assumptions for a simplified budget and require validation for a real mission.

Z.4 Generic structural-margin arithmetic

SOURCE p. 102 | Definition, explanation or informative example; no new universal limit

Z.4(a) For a purely illustrative uniaxial calculation, assume a nominal stress demand of 80 MPa, a separately justified load factor of 1.5 and an applicable allowable of 150 MPa. Factored demand is 120 MPa and the arithmetic margin is $150/120 - 1 = 0.25$.

Z.4(b) These assumed numbers are not material properties or approved factors. The example does not address multiaxial stress, fatigue, buckling, joints, defects, temperature, scatter or load-path validity. A real structural decision requires the applicable design basis and competent analysis; this calculation only demonstrates an explicit margin convention.

Source calculation note: (Z-3) $MS = \text{allowable} / \text{factored_demand} - 1$ Allowable and demand must refer to the same failure mode, units and condition. Avoid applying the same safety factor twice or omitting it through inconsistent definitions.

Z.5 Integrated ground-support case and release decision

SOURCE p. 102 | Definition, explanation or informative example; no new universal limit

Z.5(a) The synthetic ground-support cart used in Annexes B, D and W illustrates an end-to-end evidence chain. The organization defines the handling task and exposure, classifies the motion-control function, allocates requirements, approves suppliers, qualifies the process and verifies the actual hardware/software configuration.

Z.5(b) Before release, it checks dimensional acceptance using a pre-agreed decision rule, verifies the stop and control functions against the program-specific safety basis, assesses energy assumptions, closes the fixture-offset corrective action and validates operator handover. An AI inspection aid is restricted when its separate challenge-set performance is inadequate.

Z.5(c) The final release decision is requirement-based. Good OEE, a positive energy budget or a high aggregate inspection accuracy cannot compensate for missing safety verification, an unresolved configuration mismatch or an unapproved critical characteristic. The released dossier states the exact operating boundary and remaining support obligations.

Z.6 Calculation reproducibility and verification limits

SOURCE p. 102 | Definition, explanation or informative example; no new universal limit

Z.6(a) The accompanying calculation package contains deterministic synthetic data, formula implementations, computed results and figure-generation code. Arithmetic assertions check selected identities, confidence/sample-size behavior and consistency of results. This is computational verification, not independent engineering validation.

Z.6(b) Before using a method operationally, the organization should verify the implementation, software environment, input provenance, units, numerical precision and applicability assumptions. Successful arithmetic checks do not replace competent review of applicability, assumptions and operational use.

Source tables — complete field and decision payloads

Table F-1 — Calculated zero-failure sample sizes at 95% confidence

Source p. 60 | Illustrative or explanatory source table

Target success probability R_0	Required all-success trials	Interpretation
0.9000	29	A modest target still requires independent representative trials.
0.9500	59	Zero observed failures is not the same as zero true failure probability.
0.9900	299	Useful illustrative demonstration level; not an AF safety target.
0.9990	2,995	Sample burden grows rapidly as the target approaches one.
0.9999	29,956	Rare-event assurance normally requires broader engineering evidence, not a small test campaign.

Table I-1 — Comparison of two synthetic sampling plans

Source p. 67 | Illustrative or explanatory source table

Plan	Producer risk at $p=0.5\%$	Consumer risk at $p=5\%$	Interpretation
$n=105, c=2$	1.6053%	9.9187%	Meets both illustrative risk constraints.
$n=80, c=0$	33.0352%	1.6515%	Stricter against a poor lot but rejects many good-quality lots; zero acceptance is not risk-free.

Table Z-1 — Calculated quality and delivery metrics

Source p. 101 | Illustrative or explanatory source table

Metric	Definition and synthetic inputs	Calculated result / limit
First-pass yield	940 units accepted without rework out of 1,000 entering the defined process.	$940/1,000 = 94.0000\%$.
Rolled throughput yield	Three sequential stage yields 0.98, 0.97 and 0.99, using compatible conditional stage definitions.	$0.98 \times 0.97 \times 0.99 = 94.1094\%$; not the arithmetic average.
On-time delivery	92 of 100 orders due in the period delivered in full by the agreed date; cancellation/partial rules fixed.	92.0000%; denominator is due orders, not only shipped orders.
Defective units per million	7 nonconforming units out of 20,000 inspected units; each unit counted once.	350 ppm; do not confuse units with number of individual defects.

Metric	Definition and synthetic inputs	Calculated result / limit
Cost of poor quality	Scrap 18,000 + rework 12,000 + returns 9,000 + failure investigation 6,000 monetary units.	45,000; 3.0000% of an illustrative 1,500,000 revenue base.
Overall equipment effectiveness	Availability 0.90 × performance 0.95 × quality 0.98 under defined time and ideal-rate boundaries.	83.7900%; does not establish safe or conforming operation.
Earned-value cost index	Earned value 180,000 / actual cost 200,000.	CPI = 0.9000; financial progress is not technical readiness.
Earned-value schedule index	Earned value 180,000 / planned value 225,000.	SPI = 0.8000; does not measure calendar delay directly.
Evidence completion	Verified applicable requirement records / all applicable requirement records.	Report critical missing records separately; no aggregate conformity pass.
Corrective-action effectiveness	Actions meeting their pre-defined effectiveness test / actions evaluated.	State evaluation exposure; “closed on time” is a different measure.

Table Z-2 — Integrated case decision chain

Source p. 102 | Illustrative or explanatory source table

Decision	Evidence used	What is not inferred
Define scope and category	Annex A activity matrix; Annex B hazard-based category.	No automatic equivalence to an external safety-integrity level.
Control design and configuration	Requirements and interface records; Annex D trace chain.	No assumption that a model matches the physical item without reconciliation.
Establish production capability	Annexes J–L supplier, first article and special- process evidence.	One conforming first article does not guarantee every later unit.
Evaluate numerical evidence	Annexes F–I calculations and valid actual program tests.	Synthetic examples are not test results for the cart.
Control digital functions	Annexes N–O release cards, model limits and security/update evidence.	High accuracy or a secure update alone does not prove system safety.
Resolve a detected defect	Annex W occurrence/escape causes and effectiveness evidence.	Recalibration alone does not resolve earlier product impact.
Authorize release	Clause 8.6 and Annex V requirement-based evidence review.	No score-based compensation and no invented statutory approval.

Appendix B — Local implementation and release

Readiness condition	Evidence before consequential use
Authority and responsibility	Actual legal operator, owner, competent technical authority, independent reviewer and permitted result class are recorded.
Scope and criteria	Object, configuration, site, period, trigger, every technical value or observable attribute, units and prospective approval are complete.
Evidence and methods	Original accessible evidence, representative observations, valid methods, uncertainty, adverse cases and limitations support the intended conclusion.
People and independence	Competence is current for each task; genuine conflicts, relevant prior work and needed separation have been checked.
Records and tools	Field meanings, unique IDs, original history, access, retention, recovery and actual deployed workflows have passed local validation.
Decision and public use	All relevant blockers are resolved; required independent decision and written permissions precede the exact public claim.
Continuity and handover	Receiving custody, unresolved duties, corrections and historical decisions survive transfer, retirement or provider closure.

Record the completed local readiness and actual authorization in AF-FR-9100-032 or an equivalent controlled record. Preserve the unchanged source standard and each earlier decision basis. A blocked activity may continue only within a genuinely permitted development boundary, not as a provisional conformity certificate.